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CITATION:

UEDA, Gen. Quick Cash or income Maximization: Economic Significance of Premature Harvesting for Farm Forestry Smallholders in The Mount Meru Area, Tanzania. African study monographs. Supplementary issue 2018, 55: 7-26

ISSUE DATE:

2018-03

URL:

https://doi.org/10.14989/230162

QUICK CASH OR INCOME MAXIMIZATION: ECONOMIC SIGNIFICANCE OF PREMATURE HARVESTING FOR FARM FORESTRY SMALLHOLDERS IN THE MOUNT MERU AREA, TANZANIA

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ABSTRACT As East African countries face increasing destruction of natural forests and diminishing stocks of forest plantations, and as poverty alleviation continues to be a major development goal, academic and practical attention is being paid to farm forestry undertaken by smallholders growing softwood. However, there are few detailed examinations of the softwood timber value chain in these countries. The present study discusses signs of premature harvesting in the farm forestry in the Mount Meru area of northern Tanzania, and examines the economic significance of timber sawing and marketing for softwood farmers from the perspective of rural timber traders who treat sets of standing trees as a transaction unit, and on whom timber yard retailers in urban and trading centers rely greatly for access to information on rural timber availability. As reflected in rural timber traders' transaction strategies, premature harvesting was found usually to be a result of poverty, or less frequently as a way of maximizing income for farmers with access to sufficient land for woodlots; thus, the sale of premature trees is not necessarily disadvantageous to farmers. However, it was also found that the sale of small-diameter trees negatively affects the farmers' share of sales proceeds from mature trees, especially if these mature trees are sold in small quantity and are put together with small-diameter trees in a tree set for a single transaction. Although smallholder forestry certainly generates income from outside rural areas in the rapidly urbanizing regional economy, careful investigations are needed as to how the sales proceeds are distributed among the different rural participants in these transactions.

Key Words: Softwood; Farm forestry; Income distribution; Urbanization; Mount Meru; Tanzania.

INTRODUCTION

Farm forestry, or incorporation of tree husbandry into existing farming systems, by smallholders in tropical countries has attracted both academic and practical attention since it can reduce pressure on natural forests and forest plantations and therefore mitigate decreasing vegetation cover. In Tanzania, for instance, unsustainable use of indigenous broad-leaved hardwoods has led to increasing reliance on exotic conifer softwoods (Wells & Wall, 2005: 333; Schaafsma et al., 2014: 159, 164), and farm forestry is expected to play a role in the supply of softwood. Trees planted on farmland or woodlots may also support the rural livelihood of smallholders by timber sawing and marketing, and these activities can stimulate investment in replanting and reforestation (Pasiecznik, 2006).

Commodity chain and value chain analyses are approaches that examine the

potentiality of farm forestry. For East African countries, these analyses have mainly examined hardwood, for which illegal transactions are common and greater conservation measures are urgently needed (see Wells & Wall, 2005; Kalonga et al., 2015 for Tanzania, and Muhumuza et al., 2007 for Uganda). In contrast, the existing literature lacks detailed analyses of the profits of smallholders practicing softwood farm forestry (see Aoudji et al., 2012 for Benin), with a few notable exceptions that point out that the marketing process of softwood products from plantations in Tanzanian is simpler than that of hardwood products (Wells & Wall 2005: 338), and also that timber traders monopolize market information so farmer-owners of trees do not earn a substantial income in Kenya (Carsan & Holding, 2006: 27, 29). Thus, more studies from East African countries are needed to understand the interactions of forestry smallholders with rural artisanal sawyers and timber traders.

Studies report that trees on farms in East Africa are mainly of small-diameter and therefore produce small-sized timber, which the present study refers to as premature harvesting. For Kenya, where the number of mature and large-diameter trees is diminishing due to a marked increase in the demand for timber, Muthike et al. (2013: 75, 79) suggests that chainsawing as a means of sawmilling has come into widespread use because it provides an easy way to process premature trees and logs. Ngaga (2011: 45, 50) reports that Tanzanian smallholders cut their trees prematurely because of cash needs and poverty. Another Ethiopian study by Matthies and Karimov (2014) shows that farm forestry by smallholders is not based on the principle of profit maximization through mature harvesting, but instead the income is transformed into social capital. Thus, the economic significance of farm forestry for smallholders needs specific examinations, particularly to elucidate the current state of premature harvesting and its impact on timber sawing and marketing.

In the area around Mount Meru in northern Tanzania (the present study area), smallholder softwood farm forestry has been stimulated by the ongoing urbanization and construction boom in Arusha city, Arusha Region; in the vivacious mining town of Mererani in neighboring Manyara Region; and in other adjacent trading centers since the national economic liberalization of the mid 1980s (see Ueda, 2007 and 2011 for socio-economic changes in the area after economic liberalization). The research question for the present study is how the sales proceeds of timber commodity are distributed among the different transaction participants, and how this is economically significant for farmers. This study also includes an examination of the relevance of the quick cash thesis that connects premature harvesting and low-income farmers. After examining the signs that premature harvesting and/or short-rotation forestry is being conducted in the research area, the present study examines factors affecting smallholders' income from farm forestry. The study reveals the distribution of sales proceeds among the participants involved in the process from tree felling to delivery of sawn timbers and planks to retailers, furniture makers, and house builders, which is examined in isolation from the entire timber commodity/value chain. In particular, the study examines the deal between tree owners and rural timber traders, and illustrates how their share of profits changes according to traders' transaction strategies. In so doing, it is

important to pay attention to the effect the number of trees and their size distribution have in a transaction, since these variables affect marketing strategies. This tree-set approach allows us to understand distribution-related issues that are more complex than the simple monopolization of market information by timber traders.

Farmers sell standing trees from their farmland and woodlots, sawmill them into timber, and deliver them to retailers in urban and trading centers, and this timber chain is exclusively controlled by male farmers. A single farmer rarely practices all these functions, and farmers with their own specialization, no matter how temporary or intermittent, face the issue of how to distribute the proceeds from timber sales among their fellow farmers. In the colonial era, the moral right for every member to have subsistence and reciprocal welfare was embedded in the Meru society (Spear, 1997: 12, 146, 171–172, 192–193). However, differences in livelihood strategy between the land-rich and the land-poor soon began to appear (Spear, 1997: 194), and, as shown below, remain present in the current farm forestry situation with the ongoing process of individualization and socio-economic stratification of household livelihoods. Therefore, differences among the variety of participants involved in timber sawing and marketing might be overlooked by catchall application of the shared moral economy concept. Although the current state of the moral economy, especially its income equalizing effect, is worth questioning, it is beyond the scope of the present study, which concentrates on illuminating and understanding the various participants in transactions and their strategies.

The present study examines information collected in the following fieldwork: monitoring of changes in standing trees on a smallholder's farm, 2007–2014; a small-scale survey of farm forestry by buyers of seedlings from a tree nursery, 2015; a search for timber sawing records kept by rural artisanal sawyers, 2015; a small-scale survey regarding farm forestry of a random sample of 25 households (20%) in a sub-village[(1)] in Meru District, 2016 (hereafter, the 2016 sub-village household sample); and interviewing and observation of rural sawyers and timber traders, 2016–2017.

TIMBER SUPPLY IN THE RESEARCH AREA

I. Urbanization and Forest Plantation

This study examines the rural society on the southern flank of Mount Meru, Arusha Region, northern Tanzania. Arusha Region had a population of 1,288,088 in 2002 and 1,694,310 in 2012, having experienced an average annual increase in population of 2.7%. The average annual increase in population was 3.3% in urban areas, and in Arusha City, the regional capital, the increase was 2.9% from 313,004 in 2002 to 416,442 in 2012, which created demand for housing for more than 100,000 people (Tanzania, 2016: Table 2.4). Timber yards retailing wood produce are generally located at urbanization frontiers in the southern suburbs of Arusha city, including Morombo and Njiro (Fig. 1). For the present study, three

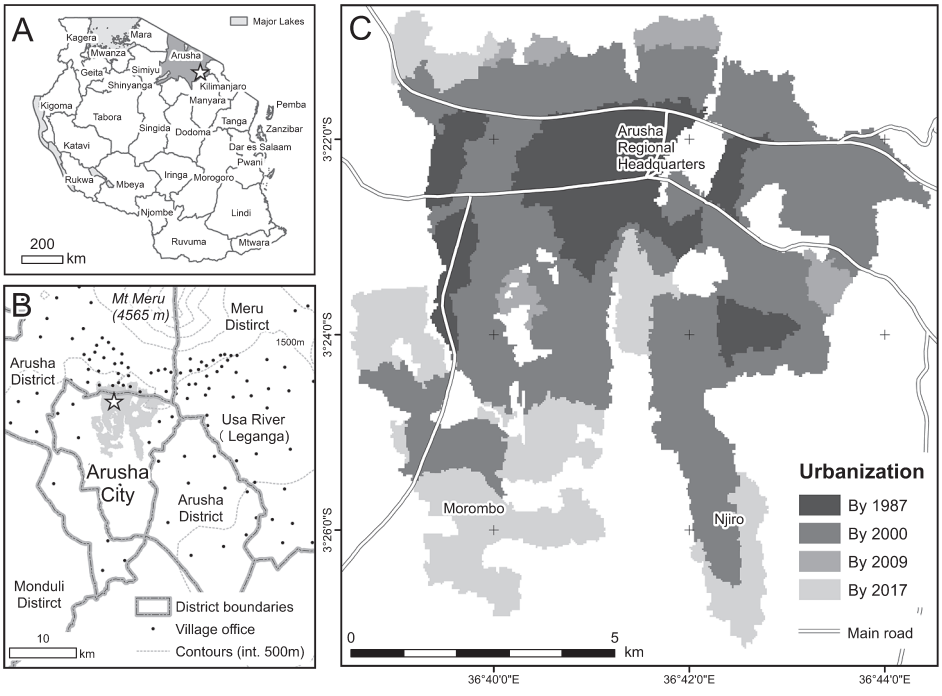

Fig. 1. An interpretation of Arusha urbanization shown with surrounding villages.
Source: NASA Landsat Program, 2007, Landsat ETM+ scene p168r062_7dt20000221, Orthorectified, USGS, Sioux Falls, February 21, 2000. NASA Landsat Program, 2008, Landsat TM scene p168r062_5dt19870225, Orthorectified, USGS, Sioux Falls, February 25, 1987. NASA Landsat Program, 2012, Landsat ETM+ scene L71168062_06220090112, Orthorectified, USGS, Sioux Falls, September 25, 2009. Google Earth, "Arusha," around 3°22' S and 36°42' E, February 3, 2017, accessed on September 8, 2017.
Note: Section A shows Arusha Region in the Tanzanian mainland. Section B shows Arusha city and its surrounding villages and rural areas. Section C is an interpretation of the urbanization process in Arusha city and in a small part of Arusha District. An image segmentation procedure was applied to bands 3, 5, and 7 of the three Landsat imageries, and the resultant image objects were visually categorized as being urban (i.e., built-up) or not at the three different time points by using the pseudo-color composite (RGB753) of each image. This interpretation was visually confirmed with the Google Earth high-resolution imagery.

villages, whose names are kept in anonymity, were selected in the jurisdiction of Meru District Council where farm forestry has been stimulated by the growing demand for timber for construction in the regional capital. The district population also increased from 231,399 in 2002 to 268,144 in 2012, and Usa River (Leganga), which is a trading center that accommodates the district headquarters, has also experienced a construction boom of shops and guesthouses since the district was created in 2007. At this and other trading centers surrounding the foot of Mount Meru, the timber yard price of grevillea timber with a cut end size of 3″×2″, which is used mainly for roof and ceiling structures, increased from TZS 170 (Tanzanian shillings) per foot in 2005 to TZS 550 per foot in 2014, which is 1.4-times the hypothetical value calculated from the annual national inflation rate between 2005 and 2014 (Consumer Price Index, National Bureau of Statistics).

The retail price for the same size timber in Arusha city reached TZS 800 between 2005 and 2016, which is 1.9-times the hypothetical value calculated for the period. The construction boom in Mererani has also resulted in increased harvesting of timber from farm forestry in the research area.

Meru/Usa Forest Plantation, which is managed by the Tanzania Forest Services Agency, has supplied Arusha Region with softwood timbers such as *Pinus patula* (41% of the total forest area), *Grevillea robusta* (14%), *Cupressus lusitanica* (9%), and *Eucalyptus maidenii* (8%), and registered sawmill customers purchase standing trees, fell them, saw the logs into timbers, and deliver them to Arusha city and to other locations (Tanzania, 2009: 11). However, the tree age structure of the plantation is skewed toward premature trees less than 10 years old (60%) due to retarded reforestation as a result of the financial problems experienced by the forest plantation authorities in the 1980s and 1990s (Tanzania, 2009: 25, and interviews at the local plantation office, Olmotonyi, Arusha, in 2015). After the peak of log production in 2003, the annual harvest drastically decreased, and since then the supply of logs to registered customers has largely been below demand; annual supply was slightly above 10,000 m^3 for the period 2008 to 2015 (Indufor, 2011: Annex 2). Arusha Region, therefore, heavily depends on timber from Sao Hill Forest Plantation in Iringa Region, southern Tanzania, which has accounted for a national market share of more than 80% in recent years. However, this plantation suffers from an acute lack of middle-aged trees, the supply of which is expected to markedly shrink for 10 years starting in 2017 (Ngaga, 2011: 46–47; Indufor, 2011: 21), which will contribute to favorable conditions for Meru farm forestry during that time period.

II. Timber Sawing and Marketing

Rural timber traders recall that the buying and selling of timber and planks in and around the sub-village investigated in the present study grew after the national economic liberalization of the mid-1980s. They claim that trade in wider planks became rare by the mid 1990s, and that premature harvesting and sawmilling of small-diameter trees has prevailed in recent years. Fig. 2 summarizes the chain of processing and marketing trees from farm forestries (all steps are taken by male farmers and workers starting from the decision to plant seedlings). Rural

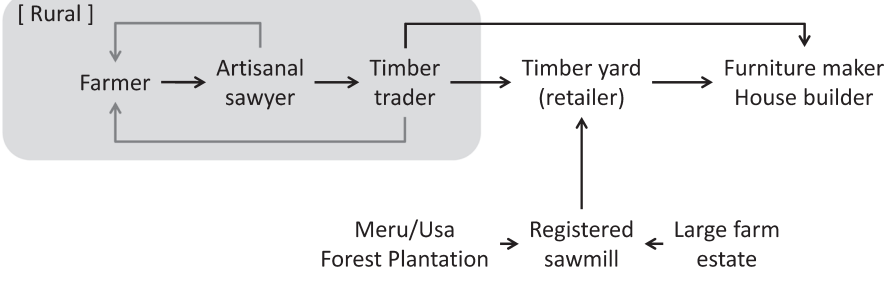

Fig. 2. The timber commodity chain.
Source: Fieldwork by the author.

timber traders are also farmers who take orders for timber products, search for suitable standing trees, negotiate prices and conditions, organize and coordinate felling and sawing procedures, and carry and buy sawn timber. They may also be asked by tree owners to buy their standing trees or to look for timber buyers. In most cases, purchase of trees and payment for sawing labor are in cash. Timber traders who have bought trees, and farmer-owners who wish to use their trees for their own consumption, need to buy a TZS-5,000 felling license per tree from the District Natural Resources Office, Meru District Council. Another fee is payable for transporting timber products outside of the village of production.

Rural timber traders ask farmer-artisans to fell standing trees that they have bought, cross-cut them into logs, and saw them into timber. Some traders have these skills and operate as artisanal sawyers too. Crosscutting into logs is done by two sawyers operating a crosscut saw. Three main types of timber are produced from logs: wider planks (*mbao upana*) with a cut end size of 10″×1″ or 8″×1″, "frame" for doors of size 6″×2″, and small-sized timber (*papi*) mainly for roof and ceiling structures of size 4″×2″ to 3″×2″ (Photo 1). Details of sawmilling are given in the next section. Timber is used in the village for house construction, delivered to timber yards at trading centers and in Arusha city, or directly sold to furniture makers and house builders located outside the village. In addition, four pieces of reject timber with bark (*mabanzi*) are recovered per log, which are sold cheaply or given away for free for rural use such as in the construction of livestock sheds. Tree branches are used for firewood in the village.

Timber yards at trading centers, and even in Arusha city, to which rural traders deliver their timber have furniture makers and house builders as their customers. In 2016, a timber yard at Usa River (Leganga) only stocked timber originating from villages on the mountainside or from a large farm estate. Another retailer also dealt only with local timber. Timber yard retailers are totally dependent on rural timber traders for access to information on timber availability in different villages, and they do not directly control the timber commodity chain up to the standing trees.

III. Sawmilling Techniques

In the research area, pit-sawing (hand-sawing) is common, which is a low-cost, small-scale technique that uses a two-person pit-saw (Photo 2). A pit is dug in the ground, which locally is called a *gereji* (from the English loan word "garage," brought by a Kenyan). This method realizes smaller losses compared with other methods because the saw has a narrow kerf, and therefore it has a high sawn timber recovery rate per log. However, labor productivity is low with this method, and it is not suitable for sawmilling of small-diameter or crooked trees; therefore, it has a low log conversion rate per standing tree. Among the seven pit sawyers who provided timber-sawing records in 2015, the most experienced sawyer started his trade in 1978.

In contrast, chainsaws have a broader kerf and a lower timber recovery rate, but this method does not discriminate log shape or diameter, and therefore has a

higher log conversion rate even from crooked trees. Chainsaws are also portable and a pit does not need to be constructed (Photo 3). The 2015 timber sawing records included five chain sawyers, and the one with the most experience was a sawyer who learned the method from a Kenyan and started chainsawing in 2007.

Another technique, bench-sawing, is not prevalent in the research area, and only a single case was encountered during the study period. Bench-sawing uses an engine-driven saw bench and a circular saw, known locally as a "sawmill." In the single case studied, the sawmill and two operators were rented from an owner stationed at a trading center. The rental fee included transportation costs, wages for the operators, and fuel costs. The kerf of a circular saw is wider than that of a pit-saw, but the loss is moderate compared with that of a chainsaw. Bench-sawing is the most efficient technique, with it taking only two days to process 50 small-diameter trees.(2) However, the timber trader who hired the saw bench needed to spend an extra TZS 20,000 per night for a watchman to guard the woodlot where it was installed.

Farmers in the research area understand that whichever softwood species is used, and regardless of the technique employed in sawmilling, timbers of the same size are equivalent for consumers, and labor charges, and retail prices at timber yards do not vary greatly. Notwithstanding the significant difference in processing time and efficiency, the labor charge for timber of a particular cut end size per foot is the same, and that is based on piecework payment depending on the total run feet.(3) This is, however, not applicable in the case where a rural timber trader, or a tree owner, uses his own equipment with the help of an employee. Thus, in the case of pit-sawing, payment for the helper is half of the total labor charge. In contrast, when it comes to chainsawing, the helper only prunes away branches, carries logs, and helps the employer in measuring for sawing; therefore, payment is not by piecework but is a fixed minimal wage. Some sawyers can process small-diameter logs with a pit-saw, but the majority of farmers and traders wishing to sell many trees rely on chainsawing to cash in on processing the trees as fast as possible.

POPULARITY OF PREMATURE HARVESTING

I. Overview of Farm Forestry in the Research Area

According to the records of tree seedling sales kept by a farmer who managed a tree nursery at his household compound, 68 customers bought seedlings for the period 2012 to 2015. Most of them purchased up to 20 seedlings, all of which were softwood (pine 75%, grevillea 19%, and cypress 6%). For those 13 farmers who bought relatively many seedlings, the median number of seedlings bought was 62 (min.: 15, max.: 3,000), the farmer's median age was 44 years old (min.: 30, max.: 75), and their main income source was agriculture and livestock for eight households, and non-agricultural source for five households. Out of the 13 farmers, nine had experience of selling their trees (median number of trees sold

in the most recent transaction, 6 [min.: 1, max.: 9]) and in processing the trees (two used pit-sawing and seven used chainsawing). Separate from this group, the 2016 sub-village household sample included 10 household heads who had sold their trees (seven household heads were more than 50 years old), of whom nine sold their standing trees without processing to rural traders in their latest trade, which is contrary to expectations currently expressed in the literature (for instance, Pasiecznik, 2006). Some of the household heads decided not to process the trees themselves because of their age and/or lack of financial resources; others needed cash to pay school fees for their dependents or for other uses. The individuals in the two separate samples were not aware of the total volume and value of timber that the traders acquired from their trees, suggesting that the farmers were pushed to agree with an unfavorable selling price in a buyers' market.

As reviewed in the first section, the existing literature suggests that farm forestry in the examined countries increasingly involves premature harvesting of smaller-diameter trees. Another farmer from the present research area provides evidence of how premature the trees harvested on his farm were for the period 2007 to 2014. He planted softwood trees (grevillea, pine, and cypress) and a small number of indigenous tree species along the boundaries of his farmland for both seasonal and perennial crops (0.44 acres, Photo 4). Of 39 trees that existed in 2007, 31 trees (79%) had been harvested by 2014 and used in the construction of the farmer's own house; thus, his trees reduced his cash spending. More recently, of 46 trees that existed in 2014, 39 (85%) were planted after 2007. The average age of the harvested trees was 8.6 years, which is indicative of short-rotation forestry and of how small the diameter of any felled trees would be.

II. Premature Harvesting as Found in Timber Sawing Records

Rural artisanal sawyers record the run feet and sizes of the timber that they saw to account for the labor they charge timber traders. These records are an important source of information, although they are often lost over time. In this study, hand-written records that 12 sawyers kept for their operation from 2008 to 2015 were collected and examined for signs of premature harvesting and increasing volume of *papi* (small-sized timber). As Fig. 3 shows, although there were some years with no recorded activity, the volume of *papi* increased in absolute terms; this relates to the popularization of chainsawing since the mid-2000s. It is also evident that the share of *papi* has increased for pit- and chainsawing as well; some rural sawyers claimed that they learned to pit-saw small-diameter trees to respond to the growing market.

Small-diameter trees have two sources: one is farmland under short-rotation forestry, as discussed in the previous section, and the other is small-scale woodlots that keep softwood trees in high density. The latter is not necessarily under short-rotation management, but may accommodate many trees of age 15 years or older, which are still considered premature due to growth at high density with no thinning. Clear-felling of dense woodlots produces many small-diameter trees for timber sawing. These woodlots are frequently seen on steeper slopes, and this style is sometimes encouraged by district administrative directives that prompt

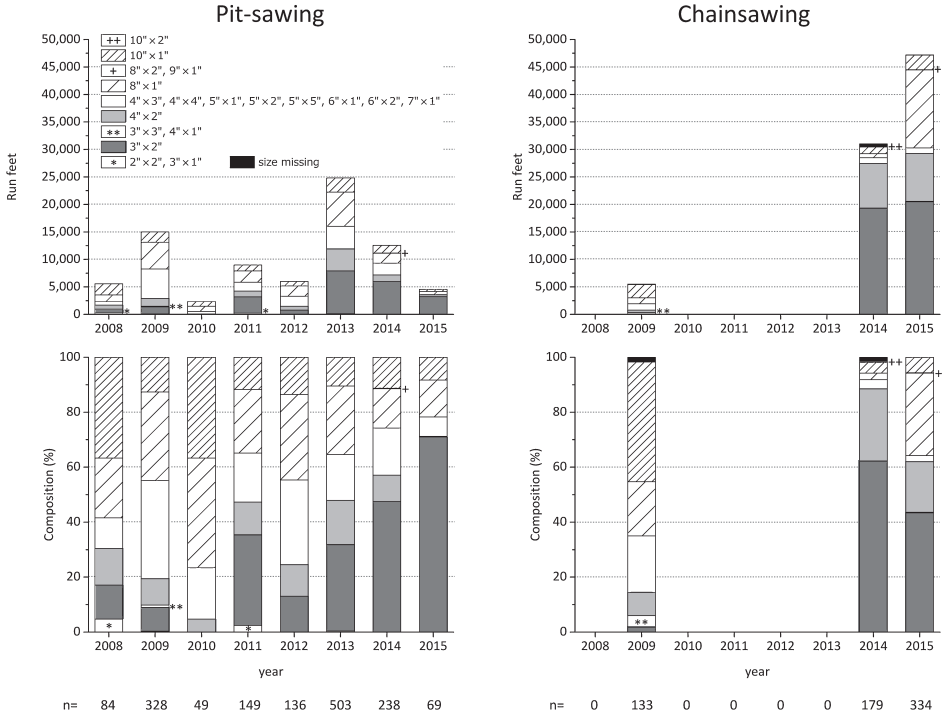

Fig. 3. Artisanal timber sawing in the research area.
Source: Fieldwork by the author.
Note: The figure *n* is the total number of timber pieces sawn and recorded by the sawyers studied.

village governments to set aside private farmland on steep slopes for reforestation. Since rural timber traders deal with trees from the dense woodlots, as well as trees from farmland, it is important to understand that the increase in *papi* shown in Fig. 3 is a result not only of short-rotation forestry but also from longer-rotation management of dense woodlots, both of which produce premature trees.

Although Meru District Council by-laws in Kiswahili prohibit the use of chainsaws (*msumeno wa mnyororo*) for felling trees and sawing timber (Meru District Council, 2015: Offense and penalties, 25(o)), and even though farmers know this, the use of chainsaws prevails. In contrast, the by-laws do not mention use of bench-saws, and rural timber traders claim that the District Council allows them to use bench-sawing because its kerf is narrower with lesser loss than a chainsaw. The by-laws also do not provide a definition of the "mature" trees they are allowed to fell, but some timber traders understand that harvest of trees below 15 years old is illegal for environmental reasons. This can be interpreted as introducing a self-styled standard that justifies clear-felling of dense woodlots that have many small-diameter trees. There is one case in the research area of a village woodlot where the village government clear-felled trees of nine years old, the sawn timbers were sold, and the sales proceeds were used for the construc-

tion of public facilities. This sort of scenario may be used as another justification for felling small-diameter trees.

It is certain that the introduction of chain-sawing, and possibly of bench-sawing, has made sawmilling of small-diameter trees quicker and easier, and has contributed to increased premature harvesting in farmland and dense woodlots. This in turn constitutes a positive feedback loop where the diameter reduction stimulates the employment of these sawing techniques.

STRATEGIES OF RURAL TIMBER TRADERS

I. Distribution of Timber Sales Proceeds

The discussion now turns to distribution of timber sales proceeds among the different participants in transactions, particularly between farmers who rarely saw their standing trees by themselves and rural timber traders, with particular focus on how the transaction strategies of rural timber traders influence this distribution of timber sales proceeds. Fieldwork in August 2016 and June 2017 recorded 11 tree/timber transactions by seven traders. The trees dealt with were mostly softwood (70 cypress, 18 grevillea trees, an avocado tree, and an indigenous tree). In deciding the buying price of one tree, traders take into account the state and value of the other trees that they simultaneously buy from the same owner. It is therefore appropriate to analyze their decision-making by examining the characteristics of the set of standing trees as a unit of evaluation.

For the 11 tree-sets (min.: 1, max.: 50, median: 4 trees), Fig. 4 shows the farmers' share of the sales proceeds, district license fees, sawyers' remuneration (traders' own labor is not considered, if they process the trees themselves), transportation costs (by a 1.5- to 3-ton truck), timber traders' share, and other costs, in increasing order of the farmers' relative share.[4] The sales proceeds distributed to farmers ranged from TZS 30,000 (lowest) to TZS 1,600,000 (highest), and the median was TZS 210,000. All timber traders operated alone, and their shared proceeds were between TZS 86,333 and TZS 4,046,000 with a median of TZS 325,120.[5] Fig. 4 also indicates the proportion of wider planks to the total volume of sawn timber, the unit buying price from the farmer, the unit selling price to the timber yard or manufacturer, and the price difference (unit selling price minus unit buying price) for each tree-set. The proportion of wider planks is a factor influencing the share of sales proceeds because the price per unit volume for wider timber is more expensive than that of *papi*.[6] The unit buying price of a tree-set is the total payment for all the standing trees in a tree-set divided by the total volume of all sawn timber, and this figure allows comparison of the value of different tree-sets, even if the trees are processed into timber of various sizes. Likewise, the unit selling price of a tree-set is calculated as the total sales proceeds from all sawn timber divided by the total volume. Both buying and selling prices are expressed as a unit price of 10″×1″ planks per foot, which was the maximum cut-end size observed. These prices were then used to calculate the difference between the unit buying and selling prices.

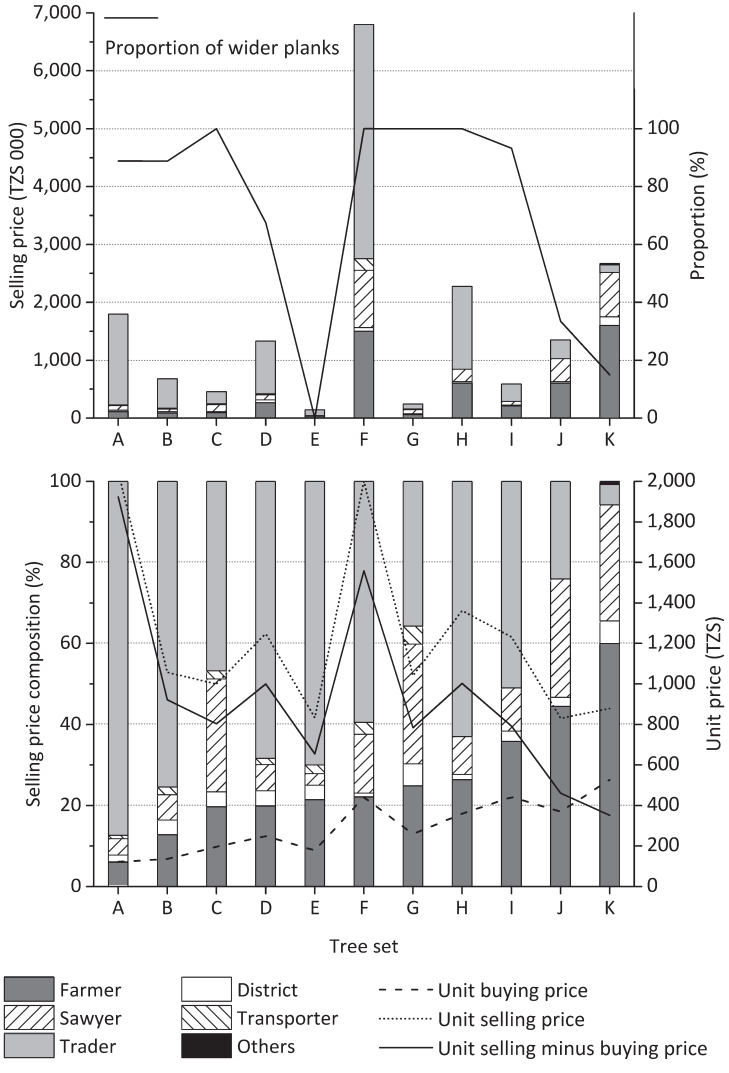

Fig. 4. Decomposition and distribution of selling price of timbers among value chain actors.
Source: Fieldwork by the author.
Note: The "Others" category includes a night watch. Timber yard retailers are not covered by this study.

Although the total number of tree-sets in the investigation is small, it is clear that rural timber traders frequently succeed in dealing more valuable wide planks in the prevalence of premature harvesting (Fig. 4). Tree-sets A, B, C, D, F, G, and J were pit-sawn, and tree-sets E, H, and I were chain-sawn. The latter might have been underrepresented due to its unlawful nature. There was only a single case of bench-sawing, Tree-set K. The total amount of timber sales of a tree-set is related to the total volume of sawn timber. Tree-set F is an exceptionally large

tree-set, and the trader bought it by paying in installments where the tree-set was delivered into two lots. The amount of timber sales shared by farmers ranged from 6.0 to 60.0% (median: 22.1%), and those shared by rural timber traders was 5.1 to 87.4% (median: 59.5%).

For rural area, the timber trade is an important basic activity, in the sense of economic base theory, which brings in income from outside the area. Many transactions are conducted between rural production areas and urban timber yards, including those located in trading centers (Photo 5). Timber yard retailers at trading centers are largely dependent on rural traders for their timber supply. The relative payment for those located outside of rural areas (i.e., owners of bench saws, transportation providers, and Meru District Council) was 9.9% at most (Tree-set G, Fig. 4), and more than 90% of the timber sales went back to rural areas to benefit artisanal sawyers, timber traders, and tree farmers. Among these rural participants, sawyers and traders work only part-time, and so their population is not easily estimated; however, in the 124 sub-village households that were randomly sampled in 2016, there were around 10 sawyers and traders, which is a clear minority.

II. Tree-set Characteristics and Transaction Strategies

Rural timber traders negotiate with farmers on the buying price of the standing trees in a tree-set, which takes into account the proportion of wider planks and the total volume of timber, and the costs and selling prices for timber buyers (Photo 6). This section explains the relationships found among the proportion of wider planks, the difference between unit selling and buying prices, the total volume of sawn timbers, and the farmers' share of the 11 tree-sets (Fig. 5).

The difference between unit selling and buying prices includes payment to Meru District Council, rural sawyers, transportation services, and others. The rates of these expenses are more or less fixed with little room for bargaining, although the degree of underreporting of the number of felled trees to the district council, which can lower these expenses, is unknown, and any difference between unit selling and buying prices predominantly reflects negotiations between farmers and timber traders. In all but one of the 11 tree-sets, farmers wanted to sell their standing trees and initiated the negotiation. The motivation behind the farmers wanting to sell their trees was known for six tree-sets: five were to accrue cash to pay school fees, expenses for house construction, and other purposes; reinvestment of part of the sales in replanting was mentioned only in one case. In this situation, the evaluated volume of sawn timbers of a tree-set is a factor that can enhance the bargaining power of farmers. The larger the sawn volume, the greater the amount of sales per unit transportation cost, and timber traders can more promptly deliver the timber to retailers and manufacturers since they have less trouble in accumulating commodities from larger tree-sets to carry them at full load.(7) When farmers try to sell a voluminous tree-set that can lead to quick and efficient delivery, their bargaining power is enhanced and the unit buying price can increase. This is evidenced by the fact that the total amount paid for standing trees exponentially increases as the total sawn volume goes up, and the cor-

relation between the total sawn volume and the unit buying price was very strongly positive (r = 0.72).

As Fig. 5 indicates, the correlation between the proportion of wider planks and the difference between the unit selling and buying prices was strongly positive (r = 0.56), and the variation in unit price difference becomes greater when the wider plank proportion is higher. This is mainly because wider planks fetch substantially higher prices and have far more room for price negotiation than do inexpensive *papi*. However, contrasting demand and supply relationships also contribute to this, as the following examination shows, when the 11 tree-sets are classified into three groups.

Two groups with a substantial proportion of wider planks can be seen (Fig. 5): Group 1 (tree-sets A and F), in which there is a large difference between the unit selling and buying prices, and Group 2 (tree-sets B, C, D, G, H, and I), in which there is a moderate difference between the unit selling and buying prices. There are two main reasons why the two groups have a moderate-to-large unit price difference (largely unit sales proceeds for timber traders): on the one hand, the unit selling price of these mainly wider planks to retailers and manufacturers tends to increase due to decreasing supply caused by premature harvesting, and on the other hand, the unit buying price for farmers tends to decrease because of the weakening power of farmers with tree-sets of increasingly small sawn vol-

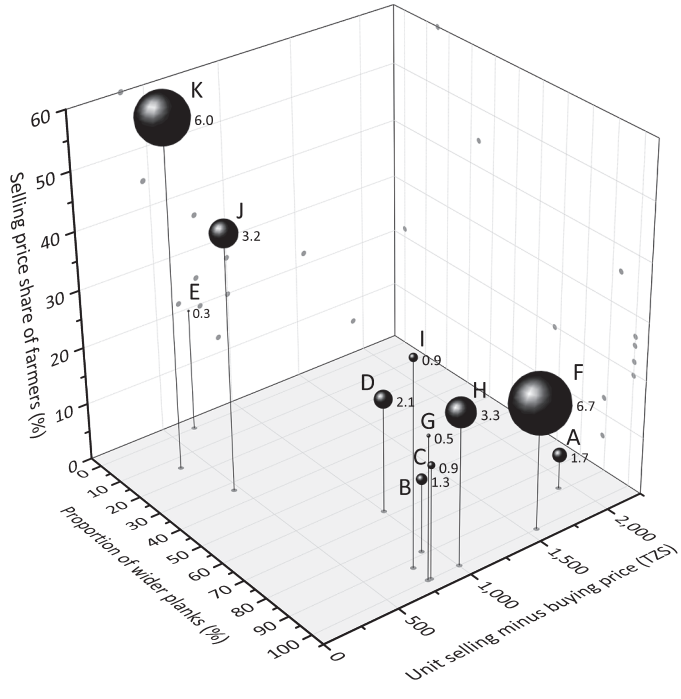

Fig. 5. Tree set characteristics, timber trade prices, and the share of farmers.
Source: Fieldwork by the author.
Note: The size of a babble indicates the total volume of sawn timber with its value in cubic meters.

ume, which again is a result of premature harvesting (tree-sets F, H, and I have exceptionally high proceeds for farmers; tree-set F is considered in the next section). For tree set A, which had the lowest farmer's share, the timber trader agreed to buy a few small-diameter trees on condition that he received a low price for a large-diameter tree in the same tree-set to increase his share.

In contrast, Group 3 (tree-sets E, J, and K) has a low plank proportion (Fig. 5). There are also two reasons why the unit price difference is small in this group, and these reasons are opposite to those for Groups 1 and 2: on the one hand, the increase in the unit selling price of *papi* is limited due to growing supply under the premature harvesting market, and on the other hand, the unit buying price goes up because of enhanced bargaining power of farmers with tree-sets of increasingly large sawn volume. Tree-set E had a small sawn total and low farmer's share and is considered in the next section.

As the difference between the unit selling and buying prices decreases at the cost of the rural timber traders, the farmers' share of sales proceeds increases ($r = -0.73$, Fig. 4). The farmers' share is the greatest when they sell a large-volume tree-set that contains many small-diameter trees, as is the case of the tree-sets in Group 3; the share of tree-set K is also the highest in absolute terms (Fig. 4). In contrast, many farmers with a small-volume, large-diameter tree-set have no choice but to accept a low share of the proceeds because of their weak bargaining power. Although tree-set F with its large sawn volume realized a great absolute share of the proceeds for the farmer, it did not exceed that of tree-set K. In a situation where chain- and bench-sawing sustain a substantial supply of small-diameter trees, long-rotation forestry, which produces a small number of high-value, large-diameter trees, not only finds it difficult to respond to the short-term cash demands of farmers but also works counter to the farmers maximizing their share. Therefore, it can be rational for them to practice short-rotation forestry and earn more in the premature harvesting market.

III. Strategies of Direct Sale and Large-Volume Delivery

Some rural traders increase their share of sales proceeds by selling sawn timber directly to manufacturers. A typical example is tree-set F (Group 1), which realized an exceptionally high share for the farmer. The farmer, in trying to pay school fees for a dependent, negotiated with two traders on the total price for his six standing trees. After rejecting both of their proposals to buy at TZS 1.1 million and TZS 1.2 million, respectively, he agreed with a third trader on TZS 1.5 million. This indicates the enhanced bargaining power of the farmer with a tree-set that was expected to yield a substantially large volume of wider planks. The trader could bid up the price because he planned to sell directly to a furniture maker at a trading center, thus avoiding timber yard retailers. Furniture makers buy directly from rural timber traders if they can have prices cheaper than timber yards, and timber traders sell with no intermediary to the manufacturers if the prices agreed with them are better than the buying price given by the timber yards. Both traders and manufacturers benefit if they agree at a price above the buying and below the selling prices of timber yards.[8] Farmers, if they want

to sell a tree-set with a large volume of mature trees, enhance their negotiation power as well as their relative share of sales proceeds to realize a substantial absolute share. Tree-set E (Group 3) was also by direct sale where the trader bought and sawmilled a single small-diameter tree, took the *papi* back home, and stored it with commodities from other tree-sets. He was going to deliver them to a house builder at a trading center, with transportation cost being at the builder's expense, once the stock reached an agreed volume.

Another important aspect of the transaction of predominantly small-diameter trees in Group 3 is the traders' strategy of large-volume delivery with a small share of the unit sales proceeds. Tree-set K is a clear-felling case of a dense woodlot resulting in a small (15%) proportion of wider planks. In addition, multiplication of District license fees by the considerable number of standing trees and the use of bench-sawing for prompt processing made the share of the sales proceeds for the timber trader narrower (Fig. 5). The share was smaller than that for tree-set E where a single tree of approximately the same size was sawmilled, and the trader raised his share by underreporting the number of felled trees to the District. Farmers' bargaining power is stronger when they sell a large-volume tree-set, even though many constituent trees are premature, and they have a particularly high share of the proceeds. The absolute share for the farmer with tree-set K became as high as that for tree-set F, which consisted of mature trees. A large share of the proceeds for another farmer was also obtained for tree-set J (Group 3), which was a large volume tree-set. These are cases of large-volume delivery to buyers outside the village in which the trees were harvested. For tree-set K, the trader sold to a timber yard located in Njiro, one of the urbanization frontiers and a more affluent residential quarter of Arusha city. For tree-set J, which was processed by pit-sawing, the total sales was around half that for tree-set K and the tree-set went to a timber yard in the mining town of Mererani.

The rural timber trader involved in tree-set F concluded another transaction of a large-volume *papi* delivery in 2016, and this is treated separately since the information collected is not comparable with the previously discussed cases. In this deal, 237 pieces of *papi* (3″×2″×10′) were sold directly to a site at an urbanization frontier in the suburb of Arusha city at TZS 6,000 per piece. A transportation fee of TZS 400 was added per piece. Same-sized timber was available at TZS 8,000 per piece in timber yards in Arusha city, many of which were from Iringa Region, southern Tanzania, with an additional cost of TZS 200 per piece for transport to the construction site. The present study did not examine the entire value chain of sawn timber and therefore no information was obtained on the proceeds or profits of timber yard retailers, and the possible buying prices at Arusha city timber yards for the final case are unknown. However, the proceeds of retailers can be as much as TZS 2,000 per piece, which is 33% of the selling price from the timber trader and 25% of the retail prices set by timber yards.

CONCLUSION

After discussing the signs of premature harvesting in farmland and woodlots

in the research area, this study examined the economic significance and implication of the timber trade for farmers, which links them to the outside market, from the perspective of rural timber traders who treat standing trees as sets in their transactions. The quick-cash thesis as an explanation of premature harvesting, as put forward by the existing literature, applies to some cases in Meru, since farmers sold small-diameter, premature trees in a buyers' market, hoping to rapidly obtain cash for payment for school fees and other expenses. Meanwhile, long-rotation management of large-diameter trees does not necessarily maximize the share of sales proceeds for farmers, because the share is negatively affected if the volume of timber from a tree-set is small. This is due to the strategies used by rural timber traders. Their strategy of delivering large volumes of *papi*, be they from farmland or from dense woodlots, found in Group 3, can be more favorable for farmers than long-rotation forestry. Therefore, the sale of premature trees is not necessarily disadvantageous to farmers. This is, however, limited to those farmers who have sufficient access to farmland both for subsistence and commercial crops, and to additional land for woodlots, and they were in the minority in the 11 cases examined. Even in the cases in Groups 1 and 2, which included a high proportion of wider planks, the share for farmers decreases if the total sawn volume of a tree-set is small and if it contains some small-diameter trees. The combination of premature harvesting and small-volume delivery does not lead to full exploitation of the farm forestry potential for many farmers, who are vulnerable to monopolization of market information by traders.

The role of the shared moral economy in alleviating income differences and reciprocating favors among transaction participants does not appear to be significant.(9) This may be because of the temporary and intermittent role played by the farmer in these transactions, although further research is needed. Issues such as economic and technical characteristics and problems in the production aspect of farm forestry are beyond the scope of this study. Further analyses of the commodity chain beyond timber yards are required, and it may be valuable to consider labor time spent by each participant and examine distributional equity (Kalonga et al., 2015). Also, considering the contribution of timber from southern Tanzania will be conductive to evaluating the macro-economic significance of local forestry in the context of urbanization and economic boom. Regarding the possible impacts of premature harvesting and decreasing tree-diameter on the agronomical/agricultural environment of farms with trees and on the slope environment of dense woodlots, long-term monitoring will be indispensable. The market situation and farm forestry in the research area may also change in relation to production recovery of the Meru/Usa and Sao Hill Forest Plantations.

It is, however, clear from the present study that a value/commodity chain analysis of timbers from farm forestry needs to use the rural traders' perspective of the tree-set as a unit of evaluation and transaction, and that related information is indispensable for proper understanding. Any value/commodity chain analysis needs to investigate the transaction reality of the commodity under consideration, if the management and utilization of the value chain (or portion of the value chain) can differ according to the transaction strategies of a particular category of participants.

ACKOWLEDGEMENTS I acknowledge the support of the Ministry of Education, Science, Sports, Culture and Technology of Japan and the Japan Society for the Promotion of Science for my research (Grant-in Aid for Scientific Research Project, No.25257107 of 2013 headed by Prof. Jun IKENO, Kyoto University). I express highest gratitude to the Tanzania Commission for Science and Technology (COSTECH), Arusha Regional Office, Meru District Office, the staff at the Olmotonyi Headquarters of the Meru/Usa Forest Plantation, and various Village Offices. The residents and respondents in Meru District are also highly appreciated for their support and collaboration.

NOTES

(1) In Tanzania, a village is divided into several sub-villages (*vitongoji*, plural of *kitongoji*), the smallest administrative unit in rural areas.
(2) Productivity of pit-sawing, chainsawing, and bench-sawing is roughly estimated to be 1, 7, and 21 respectively, based on interviews in the field and measurement of chainsawing activities to determine the number of days needed to process a given volume of trees. The productivity of chainsawing and bench-sawing was determined relative to that of pit-sawing.
(3) If a pair of pit-sawyers process 30 pieces of *papi* (4″×2″×10′) per day, each of them receives a wage of TZS 22,500 per day. This is 45% of the payment for tilling 0.25 acres of farmland, which may take three to four days.
(4) A commodity chain analysis of softwood transaction by Aoudji et al. (2012: Fig. 7) employs the term "gross profit," relying on Tallec and Bockel (2005: 4), which defines it as "the return to cultivation, once the costs of production, intermediate inputs, labor costs, interest charges and taxes have been deducted." It is impossible to calculate this figure for the farmers in the present research area because they do not record costs of production. The present study, therefore, examines the share of sales proceeds (selling prices to timber yards and other buyers) of timber products among the participants, and it does not try to estimate depreciation or any profit figures.
(5) An extremely large volume tree-set was included in this exploratory analysis because 1) with a small sample of 11 tree-sets there is no indication as to whether this is an outlier case or not, and 2) the case, alongside the other 10 cases, fits the explanatory framework that emphasizes transportation efficiency as a component of the transaction strategy of traders.
(6) For instance, the selling price of two pieces of 10″×1″×10′ timber is TZS 30,000. This is well above that of three pieces of 4″×2″×10′ *papi* (TZS 13,500) even though the total volume of the *papi* is more than that of the larger timber.
(7) The timber buyers paid transportation expenses for tree-sets H, I, J, and K. It is assumed that they also asked the rural timber traders to acquire a tree-set with a large volume, emphasizing transportation efficiency.
(8) Furniture makers appreciate timbers from the brown heartwood of mature, large-diameter trees of softwood species. It is likely that they pay premium prices for these timbers.
(9) Of the 11 tree-set transactions examined, one sale was between relatives where the trader was able to secure a lower buying price from the farmer.

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Accepted November 30, 2017

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Photo 1. Roof structures of a rural house, Meru District (19/Aug./2015).

Photo 2. Pit-sawing, Meru District (07/Jun./2017).

Photo 3. Chainsawing, Meru District (14/Aug./2014).

Photo 4. Grevillea trees planted along a farm boarder, Meru District (11/Aug./2007).
Note: The background is a hill covered by smallholder woodlots.

Photo 5. A timber yard at a trading center, Meru District (22/Aug./2015).
Note: The timber yard also sells reject timber and firewood, and manufactures furniture.

Photo 6. A standing tree bought and marked by a rural timber trader, Meru District (19/Aug./2016).